



TCE Recycle by Distillation

Nuclear Materials Technology Division

For the near-term, trichloroethylene (TCE) will be utilized for fissile weapon component cleaning for War Reserve (WR) Pit Manufacturing. TCE has excellent solvent properties, reasonable volatility, and is nonflammable. Because of the toxic, potentially carcinogenic, and mixed-waste characteristic of TCE, solvent recycle strategies are being developed.

Oils, greases, and miscellaneous materials will require removal from component surfaces and they will ultimately reside in the spent TCE wash solution along with stabilizer salts and TCE degradation products. TCE recovery was evaluated from Nye's watch Oil (higher volatility), Apiezon N grease (lower volatility), and Texaco Regal (medium volatility), and residual water and low-volatility contaminants from TCE degradation.

We tested two large-scale (10 L), single-stage distillation units that were compatible with operations in a glove box. An all stainless steel unit is the currently preferred system. The ease of operation of the distillation units were evaluated and found to be readily useable in a glove box environment. Oils and all nonvolatile materials were removed giving $\leq 0.001\%$ residue in the distillate. Water was removed to acceptable specification levels (≤ 100 ppm). As expected, TEA was not removed but codistilled with the TCE. Distilled TCE was analyzed by all the procedures initially used to certify fresh TCE and it was determined that it can be certified for reuse.

When fractions were collected, the general trends included higher water levels and lower TEA levels in the first 1-liter fraction, though TEA never went below 100 ppm in any fraction. All fractions passed the non-volatile residue analysis and approximately 95 to 97% of the TCE could be directly recycled after augmentation of the TEA levels to 200 ppm. Because water forms a low-boiling azeotrope with TCE the first liter (10% of total) was often saturated with water. Tests using molecular-sieve drying agents demonstrated that water could be removed before distillation eliminating the 10% wet fraction. Approximately, 1 to 2% of the TCE distillation bottoms would have to be managed as mixed waste. We successfully tested solidification agents that could be added to the bottoms in the distillation bag.



Omega-3 Distillation Unit



RSI-3 Distillation Unit